Wearable Inertial Sensors to Measure Biomechanical Fall Risk Factors in Older People: A Scoping Review

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Citation

N/A

Review question(s)

What are the biomechanical fall risk factors in older individuals with a history of falling or a high risk of falling, which have been measured using wearable inertial sensors? What are the anatomical locations of the inertial sensors during these measurements, and how many sensors are used? Where are the studies being conducted?

Searches

A search of the literature will be conducted in the following databases: MEDLINE, Web of Science/knowledge, Cochrane, PEDro, Embase and CINAHL. Following this a manual search of the reference lists of all included papers will be performed, there will also be forward and hand searches of the literature to provide maximum results. To ensure all relevant studies are included, there will not be any restriction of time period for included studies. No language restrictions will be placed on the eligible studies. A search strategy was developed with topic and methodological experts, which includes a variety of words from specific categories, for example: older, inertial sensors and falls.

Types of study to be included

All studies which have used wearable technology to identify biomechanical fall risk factors in older fallers or older individuals with a high risk of falling, will be included within the review. These risk factors may be obtained from clinic based testing, or from ‘real life’ environment testing, such as in the home.

Condition or domain being studied

Measured biomechanical fall risk factors with wearable inertial sensors.

Participants/population

Participants must be older adults (fallers and/or high risk of falling) (≥ 60 years) who are community-dwelling and those who live in residential care. Community-dwelling defined as individuals who live in the community unassisted. Despite not purposefully searching for particular clinical populations, they will still be included within the review, providing the studies met the entire inclusion criteria and participants are ≥ 60 years of age. Additionally, studies that included participants < 60 years will still be included, on the condition that the mean age minus one standard deviation is still ≥ 60 years.

Intervention(s), Exposure(s)

Fall risk factors identified using wearable inertial sensors. The sensors may include, accelerometers and gyroscopes or a combination of both; which when combined make up an inertial measurement unit. Biomechanical fall risk factors can be assessed using clinical tests, such as: the Berg Balance Scale, Timed Up & Go test, Tinetti Performance Mobility Assessment tool and observation of gait parameters (walking speed, step length etc.) which

can be undertaken in the home and clinical environments. Fall risk can also be measured using traditional biomechanical testing of walking gait, using a three dimensional motion capture system and a force plate, providing this is coupled with the use of wearable inertial sensors.

Comparator(s)/Control

No control

Outcome(s)

Primary Outcome

The primary outcome is to identify the biomechanical fall risk factors which have been measured using wearable inertial sensors in older fallers or older individuals with a high risk of falling, and the effectiveness of this form of measurement. In addition to identifying the setting in which fall risk assessments using wearable inertial sensors are being performed and whether this is clinic or environment based.

Secondary outcome

Secondary outcomes include, identifying the common anatomical locations of wearable inertial sensors and how many are used per measurement. Additionally, to identify whether any of the measurements have achieved validation against a 'gold standard' method of motion capture.

Data Extraction, (selection and coding)

Following the removal of duplications, the title and abstracts of studies will be independently screened by a single reviewer (MP). All included papers will then be checked by a second reviewer (VG). The potentially relevant full text papers will then be obtained and independently screened by two reviewers (MP, VG) for inclusion in the review. The FARSEEING taxonomy (Boulton *et al*., 2016) which is a piloted online data extraction form will be used to extract relevant data and to fully assess each paper. A single reviewer (MP) will extract the appropriate data from all studies, such information includes: title, authors, year of publication, journal, country of origin, design, measurement setting, duration, sample size, biomechanical fall risk factors, type of wearable inertial sensor used and the anatomical location of the sensor, in addition to the concurrent measures used to assess fall risk, and finally any information regarding the validation of sensor based measurements. When possible, key data regarding fall risk factors will also be extracted for older fallers and high risk of falling individuals. Discrepancies between reviewers one (MP) and two (VG) will be settled with assistance from a third party (AP) when required. If data is missing from any study included in the review, the respective authors will be contacted.

Risk of bias (quality) assessment

Not applicable, this is a scoping review, therefore a risk of bias quality assessment is not necessary. Nevertheless, studies may be critiqued during the discussion.

Strategy for data synthesis

The review will include a narrative scoping approach towards data synthesis, to determine the biomechanical fall risk factors which can be measured using inertial sensors in older fallers and high risk of falling individuals; as opposed to what can generically be measured using inertial sensors. All extracted data will be tabulated descriptively. Additionally,

biomechanical fall risk factors may be grouped into different categories (e.g. dynamic and static balance etc.).

Analysis of subgroups or subsets

There will be no subgroup analysis.

Dissemination plans

This review will be included within a doctoral thesis. The plan is to publish this research as a manuscript in a peer-reviewed journal, in the field of health sciences and presented at relevant conferences.

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Anticipated or actual start date

January 2017

Anticipated completion date

June 2017

Funding sources/sponsors

Engineering and Physical Sciences Research Council, Doctoral Training Partnership

Conflicts of interest

No known conflicts of interest

Language

English

Country

United Kingdom

Subject index term status

Subject indexing assigned by CRD

Subject index terms

Biomechanical Fall Risk Factors; Older; Wearable Inertial Sensors

Stage of review

Ongoing

Date of registration in PROSPERO

N/A

Date of publication of this revision

N/A

DOI

N/A

Stage of review at time of this submission	**Started**	**Completed**
Preliminary searches	Yes	Yes
Piloting of the study selection process	Yes	Yes
Formal screening of search results against eligibility criteria	Yes	Yes
Data extraction	No	No
Risk of bias (quality) assessment	No	No
Data analysis	No	No